300060

FLOOD INSURANCE STUDY

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CITY OF DEER LODGE AND POWELL COUNTY, MONTANA

OCTOBER 15, 1980

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER -300060

FEMI.209:

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

FLOOD INSURANCE STUDY

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the unincorporated areas of Powell County, Montana, and the incorporated City of Deer Lodge, Montana, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Powell County and the City of Deer Lodge to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

Streams requiring detailed study were identified at a meeting attended by representatives of the City of Deer Lodge, Powell County, the Floodplain Management Bureau of the Montana Department of Natural Resources and Conservation, the Federal Insurance Administration, and the study contractor on June 21, 1977.

Coordination was maintained throughout the study with the City of Deer Lodge Zoning Committee and the Powell County Planning Board.

The results of this study were reviewed at a final community coordination meeting held on May 15, 1980. Attending the meeting were representatives of the Federal Insurance Administration, the study contractor, Montana Department of Natural Resources, and the county. No problems were raised at the meeting.

1.3 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by Morrison-Maierle, Inc., for the Federal Insurance Administration, under Contract No. H-4579. This work, which was completed in April 1979, covered all significant flooding sources affecting the City of Deer Lodge and Powell County.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Powell County, Montana, and the incorporated City of Deer Lodge, Montana. The area of study is shown on the Vicinity Map (Figure 1).

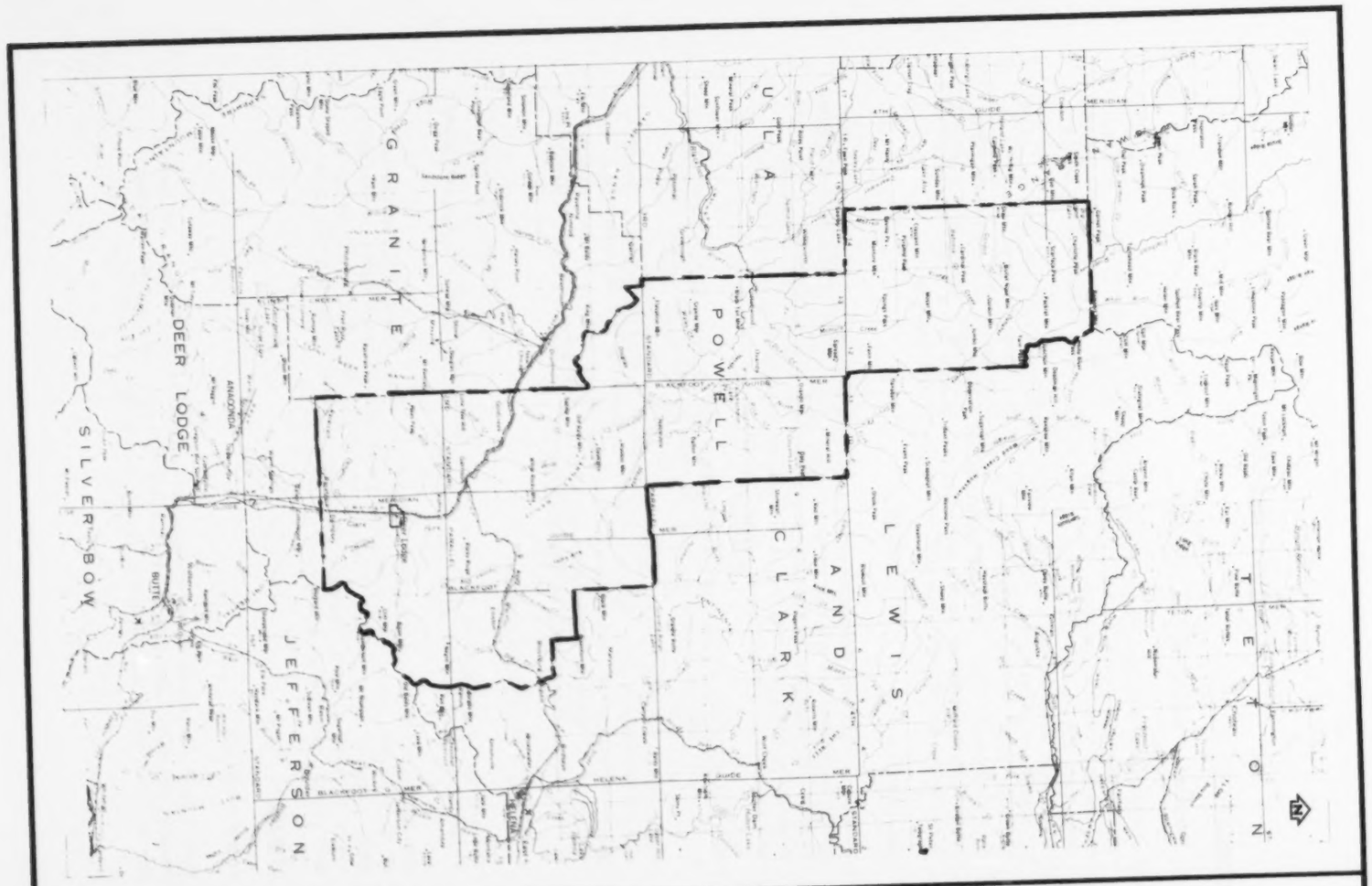

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF DEER LODGE AND POWELL CO, MT

APPROXIMATE SCALE

16 0 16 32 48 MILES

VICINITY MAP

Separate Flood Insurance Rate Maps have been prepared for Powell County and the City of Deer Lodge; however, Powell County and the City of Deer Lodge are covered in this text.

The following watercourses were studied by detailed methods:

Clark Fork, from 275 feet upstream from its confluence with Peterson Creek to 100 feet downstream from its confluence with Cottonwood Creek

Cottonwood Creek, from its confluence with Clark Fork upstream to the upstream side of Interstate Highway 90 and Frontage Road

Peterson Creek, from its confluence with Clark Fork upstream to Interstate Highway 90

The following streams and portions of streams were studied by approximate methods due to their lack of development potential or minimal flood hazards:

Clark Fork, from the Missoula County limits upstream to the downstream limit of detailed study north of the City of Deer Lodge

Clark Fork, from the upstream limit of detailed study south of the City of Deer Lodge, upstream to the Deer Lodge County limits

Cottonwood Creek, from Interstate Highway 90 east of the City of Deer Lodge, upstream to the mouth of Baggs Creek

Cottonwood Creek, from its confluence with Blackfoot River to approximately 14,000 feet upstream

Cottonwood Creek, from its confluence with Douglas Creek to approximately 3000 feet upstream

Peterson Creek, from Interstate Highway 90 east of the City of Deer Lodge to approximately 10,000 feet upstream

Blackfoot, North Fork Blackfoot, and Little Blackfoot Rivers

Telegraph, Johnson, Taylor, Tin Cup Joe, Monture, Nevada, Douglas, Baggs, and Spring Creeks

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1984.

2.2 Community Description

Powell County is along the western slope of the Continental Divide in west-central Montana and has an area of 2337 square miles. It is bordered by Flathead County on the north, Lewis and Clark County on the east, Jefferson County on the southeast, Deer Lodge County on the south, Granite County on the southwest, and Missoula County on the northwest.

Significant numbers of settlers from the east began arriving in Powell County in the mid-19th century. Gold was first discovered in Montana at Gold Creek, near Garrison, Powell County, in 1852. Word of this strike and others eventually brought thousands of prospectors to Montana. However, by the 1960-to-1970 period, the net migration was -960 due to a decrease in mining and logging activities. The main industries employing Powell County residents are agriculture, manufacturing, transportation, retail trade, and services. Powell County had an estimated 1975 population of 7400 residents. Population projections for Powell County indicate a strong growing trend with a population increase in 1990 of 27 percent over the 1980 population projections (Reference 1).

The City of Deer Lodge is in south-central Powell County. It was established as a trading center to supply the mining population with food and supplies. Deer Lodge, originally called Cottonwood, became one of the early farming and ranching centers of the state. The first Federal penitentiary in Montana was located in Deer Lodge, and it became a state prison in 1893. The Northern Pacific Railway (now Burlington Northern Railroad) reached Powell County in 1883 and was followed by the Chicago, Milwaukee, St. Paul & Pacific Railroad, which located shops in Deer Lodge in 1908. Deer Lodge, the Powell County seat, had an estimated population in 1975 of 4700, an increase of 9 percent above the 1970 population (Reference 1). The principal employers in Deer Lodge are the state (operating the penitentiary) and the Burlington Northern and Chicago, Milwaukee, St. Paul & Pacific Railroads. An oblique aerial photograph of the City of Deer Lodge and the Clark Fork valley is presented in Figure 2.

Powell County, in the Columbia River basin, is drained by Clark Fork and Blackfoot River (Reference 2). Clark Fork originates at the Continental Divide near Butte and flows generally northwesterly through Deer Lodge and Missoula to Pend Oreille Lake in Idaho. Blackfoot River originates at the Continental Divide west of Lincoln and flows westerly to converge with Clark Fork just above Missoula.

Cottonwood Creek flows through an established residential area in Deer Lodge and empties into Clark Fork near the northern corporate limits. It drains a 46-square-mile area east of Deer Lodge, and elevations within the watershed range from 4500 to 8500 feet.

Figure 2. City of Deer Lodge and Clark Fork Valley

Higher elevations within the basin are rugged and forested, and the lower elevations are generally rolling grasslands which have been developed for pasture and irrigated farming. Deer Lodge is in the lowest portion of the Cottonwood Creek basin.

Peterson Creek flows through Deer Lodge along the southern corporate limits. Areas to the north of the creek are mainly residential, and areas to the south are farmlands.

Powell County has irregular topography, and elevations range from 4,000 to 10,000 feet. Therefore, there are large variations in climate. Annual precipitation averages vary considerably in different areas. They are highest in the mountains of the northern section of the county where the annual average is approximately 60 inches and lowest in the Clark Fork valley where the average is slightly more than 10 inches. In the valleys, the wet season is generally during the May to July period, and only small variations occur throughout the rest of the year. In the mountains, the precipitation pattern is more complicated and variable.

In Deer Lodge, the average temperatures for January and August are 17°F and 63°F, respectively. The average number of days between the last spring and first fall frost is 95 at Deer Lodge (Reference 2).

Physiographically, the county consists of high mountain ranges and sediment-filled valleys on either side of the main streams. Geologic materials vary widely and include granite, rhyolite, basalt, argillite, quartzite, limestone, shale, sandstone, and recent alluvium. Soils of the grassland and farming areas belong in the Chestnut and Chernozem zonal groups. Significant inclusions of Rogosols and Lithosols with alluvial and Humic Gley soils are found in the stream valleys. Soils developed under a dense conifer forest belong in the Gray Wooded and Podzol great soils groups. Most of the Gray Wooded and Podzol soils found in Powell County lie in areas of native forest (Reference 2).

2.3 Principal Flood Problems

Clark Fork flows through the center of Deer Lodge and causes infrequent minor flooding to developments on old river channels and the lower river banks. These developments include several residential and commercial areas.

Floods have been recorded in 1948, 1964, and 1975, but no information is available on their discharges or estimated recurrence intervals. The maximum flood, however, occurred in 1964.

Flooding on Cottonwood Creek occurs during late spring when the thawing action of heavy, warm rain acts on a lingering winter snowpack. Local people have reported major floods in 1908, 1916, 1917, 1928, 1948, and 1964. Figures 3, 4, and 5 show flooding in June 1964

Figure 3. Powell County High School Shop Building in June 1964 (Courtesy of U.S. Army Corps of Engineers)

Figure 4. Erosion Caused by 1964 Flood Along Street at Powell County High School (Courtesy of U.S. Army Corps of Engineers)

Figure 5. Flooding 2 Days After Peak of 1964 Flood at Powell County High School Shop Building (Courtesy of U.S. Army Corps of Engineers)

in Deer Lodge. This flood had an estimated discharge of 1140 cubic feet per second (cfs) and an estimated recurrence interval of 100 years (Reference 3).

Floods on Cottonwood Creek with discharges of less than 1500 cfs would pass through the twin culverts under Interstate Highway 90 and Frontage Road if no debris blockage or sedimentation occurred in the culverts. Larger floods, in excess of the twin culvert capacity, would pond above Interstate Highway 90 and Frontage Road and cause flows to be transferred through the Johnson Creek culvert, the Milwaukee Avenue underpass, and a 36-inch culvert just south of the underpass.

The Cottonwood Creek channel gradient varies from 100 to 800 feet per mile above Deer Lodge and averages approximately 50 feet per mile through the city. This stream gradient is steep enough for high-velocity floodflows to occur. The velocity is a substantial factor in causing flood damage. Past floods have caused considerable bank erosion in the city. Channel capacity progressively decreases below the Interstate Highway 90 culverts, therefore, overbank flow will occur with floods of recurrence intervals as low as 10 years. Nearly all overbank flow will be stopped by the railroad embankments and returned to Cottonwood Creek.

Peterson Creek flows through Deer Lodge at the southern corporate limits. The perched channel near the downstream end may be a hazard to potential development on the southern side of the creek.

Other small streams within Deer Lodge (Tin Cup Joe and Taylor Creeks) have flood histories similar to those mentioned previously, but have less resulting total damage.

2.4 Flood Protection Measures

Flood protection measures in Powell County are limited to a few local levees. Little information exists on the design and construction of these levees, and no accurate estimate of the flood protection they provide can be made.

Several channel modifications have been made on Cottonwood Creek in Deer Lodge. A levee has been constructed on the northern side of the creek at the Burlington Northern Railroad tracks. Concrete walls, log cribs, and stacked rock walls form the channel banks through much of the city. These modifications may provide some protection at low flows for some locations, but, for the most part, they have seriously reduced the channel capacity. Figures 6, 7, and 8 show channelization along Cottonwood Creek.

A levee on the northern side of Peterson Creek extends from Clark Street upstream to the vicinity of Carter Street in Deer Lodge . The levee height varies from 2.5 to 3.5 feet and appears to be pushed-up local material. The construction of this levee did not comply with the Federal Insurance Administration Levee Policy (Reference 4) and, therefore, was not considered in this analysis.

Figure 6. Natural Channel of Cottonwood Creek, just Upstream of Interstate Highway 90 and Frontage Road Twin Culverts

Figure 7. Channelization of Cottonwood Creek Caused by Residential Development

Figure 8. Typical Channel Encroachment and Obstruction Caused by Structures on Cottonwood Creek

The 100-year flood plain delineation (Reference 3) of the Montana Department of Natural Resources and Conservation was used by the Deer Lodge Zoning Commission to establish local flood plain management regulations.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual occurrence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the community.

Long-term flow records are not available for Cottonwood Creek; no flow records are available for Peterson Creek. For Clark Fork, no records which could be used to determine peak discharges are available within the study area.

A U.S. Geological Survey crest gage station has been in operation on Cottonwood Creek at Deer Lodge, Station No. 12324250, since September 1975, but there are insufficient data to be useful in this report.

However, continuous long-term records by the U.S. Geological Survey on several tributary drainages within the upper Clark Fork basin, in addition to several gages located considerably down stream of the study area, are available. The upper Clark Fork basin records provided the basis for the regional analysis techniques (References 5 and 6) that were used to determine peak discharges for Clark Fork and Peterson Creek.

Streams that were used for developing regional analyses are listed below:

Gage	Gage Station Number	Years of Record
Flint Creek at Maxville	12329500	36
Boulder Creek at Maxville	12330000	38
Middle Fork Rock Creek Near Philipsburg	12332000	39
Nevada Creek Above Reservoir Near Finn	12335500	31
Clark Fork Tributary Near Drummond	12324700	21
German Gulch Creek Near Ramsay	12323500	25
Racetrack Creek Below Granite Creek, Near Anaconda	12324100	25

For Cottonwood Creek, the Department of Natural Resources and Conservation of the State of Montana approved the official 100-year flood plain in March 1975 (Reference 7). This designated area resulted from the Department of Natural Resources and Conservation hydrologic study of Cottonwood Creek (Reference 3) which indicated that the 1964 flood event was equivalent to a 100-year flood. The Department of Natural Resources and Conservation analysis involved a comparison with the U.S. Geological Survey gaging station on Nevada Creek above the Reservoir near Finn Station No. 12335500, which was similar to the ungaged Cottonwood Creek area. The Department of Natural Resources and Conservation hydrologic analysis on Cottonwood Creek (Reference 3) was used for this Flood Insurance Study. The results of this analysis fall within the tolerable limits of the regional analyses performed on Clark Fork and Peterson Creek.

Peak discharges for Peterson Creek were based on a regional analysis which related flood magnitudes to certain basin characteristics. The U.S. Geological Survey report, A Method for Estimating Magnitude and Frequency of Floods in Montana, (Reference 5) was the source of this procedure. Drainage area, main-channel slope, and mean annual precipitation are the most significant parameters used in this method.

A regional analysis similar to the one performed on Peterson Creek, was made for Clark Fork. The method outlined in U.S. Geological Survey Water-Supply Paper 1687 (Reference 6) was used to determine peak discharges on Clark Fork. With this method, the most significant parameters are drainage area, average annual runoff, and the area of lakes and ponds. This method was selected over the U.S. Geological Survey method used on Peterson Creek (Reference 5) because the results closely matched a statistical analysis of gaged stations within the upper Clark Fork basin.

Peak discharge-drainage area relationships for Clark Fork, Cottonwood Creek, and Peterson Creek are shown in Table 1.

Table 1. Summary of Discharges

Flooding Source And Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
Clark Fork At Milwaukee Avenue Bridge	1005	6,340	8,470	9,410	12,000
Cottonwood Creek Just Upstream of Interstate Highway 90 and Frontage Road	45.4	517	833	1,140	2,000
Peterson Creek At Mouth	30.3	220	430	540	1,000

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of streams in the county and community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each stream studied in the county and community.

The HEC-2 Water-Surface Profiles computer program developed by the U.S. Army Corps of Engineers (Reference 8) was used to determine the water-surface elevations along each stream studied in detail.

Cross section data for the streams were obtained by field surveys performed by the study contractor and the Montana Department of Natural Resources and Conservation and aerial photogrammetric interpretation (Reference 9). Structures were field surveyed in order to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Manning's "n" values used in the hydraulic computations were chosen by engineering judgment using U.S. Geological Survey Water-Supply Paper 1849 (Reference 10). Clark Fork channel "n" value was 0.035, and overbank values ranged from 0.05 to 0.06. Cottonwood Creek channel "n" values ranged from 0.03 to 0.05, and overbank values ranged from 0.03 to 0.06. Peterson Creek channel "n" values ranged from 0.04 to 0.045, and overbank values ranged from 0.05 to 0.08.

The starting water-surface elevations for all streams were determined by the slope-area method.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

On Cottonwood Creek, the HEC-2 program (Reference 8) was calibrated to represent the 100-year flood plain flood profile established by the Department of Natural Resources and Conservation (Reference 3) based upon the 1964 flood (a 100-year event). The 1964 100-year flood caused sheet flooding of less than 1 foot in an area north of the Cottonwood Creek channel. In order to model the Cottonwood Creek flood plain geometry to match the 1964 flood, the cross section data were shortened to the flood widths observed in the 1964 event, as delineated by the Department of Natural Resources and Conservation.

At the upper limit of the study, the entire 500-year flood of 2000 cfs will not pass through the twin culverts on Cottonwood Creek under Interstate Highway 90 and Frontage Road. These culverts have a capacity of only approximately 1500 cfs. The remaining 500 cfs is divided between the Johnson Creek culvert and the Milwaukee Avenue underpass.

Approximately 200 cfs will be diverted through the Johnson Creek culvert and will not return to the Cottonwood Creek channel. The remaining 300 cfs will pass through the Milwaukee Avenue underpass and rejoin the Cottonwood Creek flood plain. Flooding from this flow will be less than 1 foot.

The Peterson Creek flood plain is contained within a channel configuration with the exception of the south bank area between Fourth and Main Streets. A low spot in this area will allow the 100- and 500-year water-surface elevations to overtop the south bank. The overbank flow in this section of Peterson Creek will cause sheet flooding to the south of this area. The HEC-2 program (Reference 8) was adapted to this situation by coding in enough of the southern half of Cross Section B to keep the 100- and 500-year water-surface elevations 0.1 to 0.3 foot above the lowest bank elevations.

Approximate elevations were determined by using flood-prone area maps (References 11 and 12), topographic maps (References 13 and 14), aerial photographs of past floods (Reference 15), and other aerial photographs (Reference 9). For the streams studied by approximate methods that were adjacent to detailed areas, average depths of flow were estimated from the adjacent detailed-study areas. On Johnson Creek, hand calculations of normal depth were made at various locations.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage State and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Insurance Administration as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were developed photogrammetrically, using aerial photographs at a scale of 1:24,000 (Reference 9).

Approximate flood boundaries for Clark Fork and Little Blackfoot River were delineated by using aerial photographs of the June 21, 1975, flood taken by the U.S. Geological Survey (Reference 15). The 100-year flood delineation was interpreted from these photographs, from topographic maps (References 13 and 14), and field surveys of roadbeds and other major structures that affected the floodflows. Approximate flood boundaries for Blackfoot and North Fork Blackfoot Rivers and Monture, Nevada, Douglas, portions of Cottonwood, and Spring Creeks were delineated by using flood-prone area maps (References 11 and 12). Approximate flood boundaries for Telegraph Creek were delineated by using topographic maps (References 13 and 14). Approximate flood boundaries for Peterson Creek and portions of Cottonwood Creek were delineated by using aerial photographs (Reference 9) and topographic maps (Reference 13). Approximate flood boundaries for Johnson Creek were delineated by using aerial photographs (Reference 9) and topographic maps (Reference 16). Approximate flood boundaries for Taylor and Tin Cup Joe Creeks were delineated by using aerial photographs (Reference 9). Approximate flood boundaries for Peterson, portions of Cottonwood, Johnson, Taylor, and Tin Cup Joe Creeks were verified by field inspection.

In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown.

Approximate flood boundaries in some portions of the study area were taken from the Federal Insurance Administration's Flood Hazard Boundary Map (Reference 17).

Flood boundaries for the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2).

Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity and increases flood heights, thus increasing flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, the Federal Insurance Administration limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

In Montana, however, encroachment in the flood plain is limited to that which will cause an increase in flood heights of 0.5 foot. Therefore, at the recommendation of the Montana Floodplain Management Bureau, a floodway having no more than a 0.5-foot surcharge has been delineated for this study.

The floodways were computed on the basis of equal-conveyance reduction from each side of the flood plain. The exceptions to this are in segments where the encroachment in one overbank was to the edge of the channel. In such cases, additional encroachment was taken in the opposite overbank; if there was enough area available.

The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood boundaries are close together, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.5 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 9.

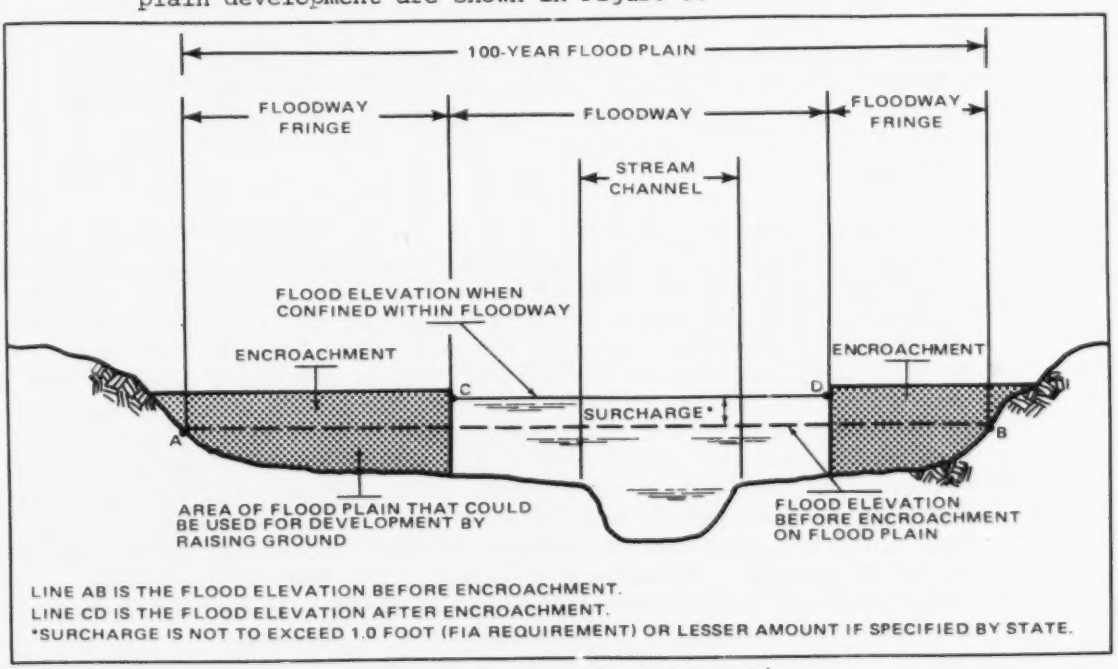
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure 9. Floodway Schematic

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Clark Fork								
A	0	792	2211	4.3	4500.2	4500.2	4500.5	0.3
B	1600	578	2038	4.6	4506.3	4506.3	4506.3	0.0
C	2841	150	1280	7.4	4512.5	4512.5	4512.5	0.0
D	4551	204	1714	5.5	4519.5	4519.5	4519.7	0.2
E	6331	403	3674	2.6	4522.7	4522.7	4523.0	0.3

[1]Feet Above Cross Section A

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF DEER LODGE AND POWELL COUNTY, MT

FLOODWAY DATA

CLARK FORK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Cottonwood Creek								
A	1660	29	142	8.0	4511.1	4511.1	4511.2	0.1
B	1830	149	603	1.9	4513.7	4513.7	4513.8	0.1
C	2605	429	436	2.6	4516.2	4516.2	4516.7	0.5
D	3415	240	350	3.3	4524.7	4524.7	4524.8	0.1
E	4185	250	406	2.8	4530.4	4530.4	4530.7	0.3
F	4785	274	293	3.9	4536.0	4536.0	4536.0	0.0
G	5245	285	636	1.8	4542.8	4542.8	4543.1	0.3
H	6675	72	209	5.5	4558.4	4558.4	4558.6	0.2
I	7565	72	213	5.4	4571.1	4571.1	4571.1	0.0

[1]Feet Above Mouth

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF DEER LODGE AND POWELL COUNTY, MT

FLOODWAY DATA

COTTONWOOD CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Peterson Creek								
A	450	31	65	8.3	4524.8	4524.8	4524.8	0.0
B	1270	179	143	3.8	4536.5	4536.5	4536.7	0.2
C	1690	68	132	4.1	4544.4	4544.4	4544.9	0.5
D	2470	31	80	6.8	4556.6	4556.6	4556.6	0.0
E	3760	30	66	8.2	4581.1	4581.1	4581.2	0.1

[1]Feet Above Mouth

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Insurance Administration has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting Powell County and the City of Deer Lodge.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of Powell County and the City of Deer Lodge are shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the Federal Insurance Administration device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective Flood Hazard Factors, the entire unincorporated area of Powell County and the

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Clark Fork							
Reach 1	0001,1340	-1.0	-0.3	0.7	010	A2	Varies - See Map
Reach 2	0001	-2.0	-0.6	1.6	020	A4	Varies - See Map
Reach 3	0001,1340	-2.9	-0.8	1.2	030	A6	Varies - See Map
Cottonwood Creek							
Reach 1	0001,1340	-1.0	-0.4	0.5	010	A2	Varies - See Map
Reach 2	0001	-0.7	-0.3	0.3	005	A1	Varies - See Map
Reach 3	0001,1340	-2.0	-0.9	1.1	020	A4	Varies - See Map
Peterson Creek							
Reach 1	0001,1340	-1.0	-0.3	0.8	010	A2	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF DEER LODGE AND POWELL COUNTY, MT

FLOOD INSURANCE ZONE DATA

CLARK FORK-COTTONWOOD CREEK- PETERSON CREEK

incorporated area of the City of Deer Lodge were divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or Flood Hazard Factors determined.
Zones A1, A2, A4, and A6:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to Flood Hazard Factors.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.
Zone D:	Areas of undetermined, but possible flood hazard.

The flood elevation differences, Flood Hazard Factors, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Maps for Powell County and the City of Deer Lodge are, for insurance purposes, the principal result of the Flood Insurance Study. These maps (published separately) contain the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. These maps are developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Insurance Administration.

6.0 OTHER STUDIES

Following the 1964 flood on Cottonwood Creek, several groups and agencies became involved in the delineation of flood boundaries and establishment of flood plain management guidelines. A Flood Insurance Study by the U.S. Army Corps of Engineers, Seattle District, in June 1966 (Reference 18) established a water-surface profile and map of the actual 1964 flood boundaries. Another U.S. Army Corps of Engineers report (Reference 19) in June 1972 delineated Cottonwood Creek flood-prone areas which were much larger than the actual flooded areas in the 1964 flood. This report determined that the 1964 flood had a recurrence interval of 23 years and estimated a 100-year discharge of 1800 cfs.

Because of local concern, Deer Lodge lending institutions hired a consulting engineering firm to review the Cottonwood Creek flood plain delineation established by the U.S. Army Corps of Engineers (Reference 18). This hydrologic investigation (Reference 20) indicated that the 1964 flood was greater than a 100-year flood and provided evidence to support a 100-year discharge equal to 927 cfs. This information was offered as testimony at a public hearing conducted by the Floodplain Management Bureau of the Montana Department of Natural Resources and Conservation, the conclusions of which (Reference 3) were presented at another public hearing on February 2, 1975. The City of Deer Lodge Flood Hazard Boundary Map (Reference 20) and the supporting hydrologic analysis (Reference 3) showing a 100-year discharge equal to 1140 cfs were accepted by the Montana Department of Natural Resources and Conservation on March 10, 1975 (Reference 7). The Flood Hazard Boundary Map for the City of Deer Lodge (Reference 17) and the Montana Department of Natural Resources and Conservation Flood Hazard Map (Reference 3) are both in agreement with this Flood Insurance Study.

In 1973, the U.S. Soil Conservation Service investigated the Cottonwood Creek drainage and prepared a preliminary analysis (Reference 21) dealing with potential developments for flood protection, water supply, and irrigation. No further action on this proposal has taken place.

The U.S. Geological Survey Flood-Prone Area Maps (References 11 and 12) covering the Blackfoot River area are in agreement with this Flood Insurance Study.

The remaining areas of this Flood Insurance Study have not had previous flood-related studies.

This study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, Building 710, Denver Federal Center, Lakewood, Colorado 80225.

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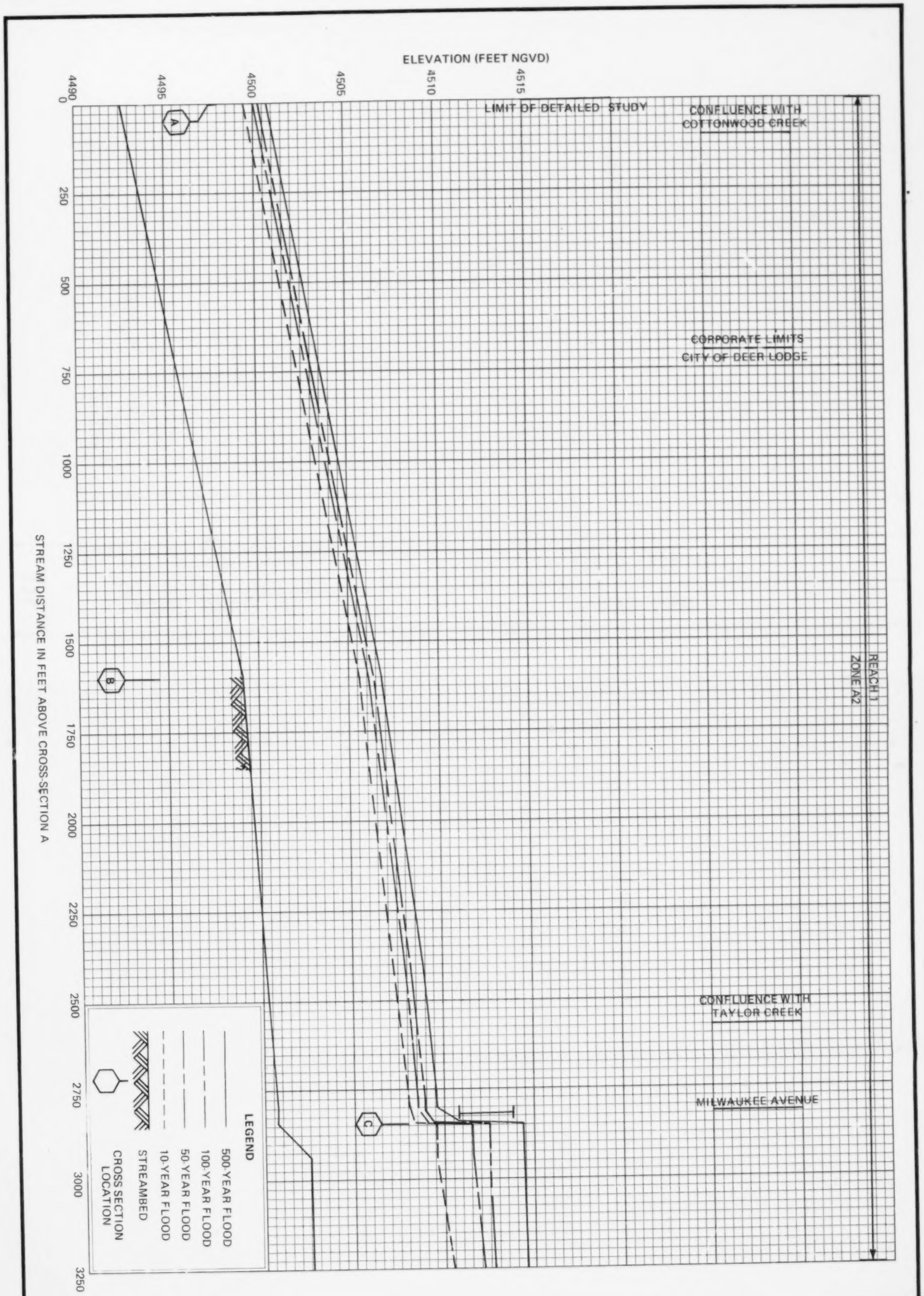


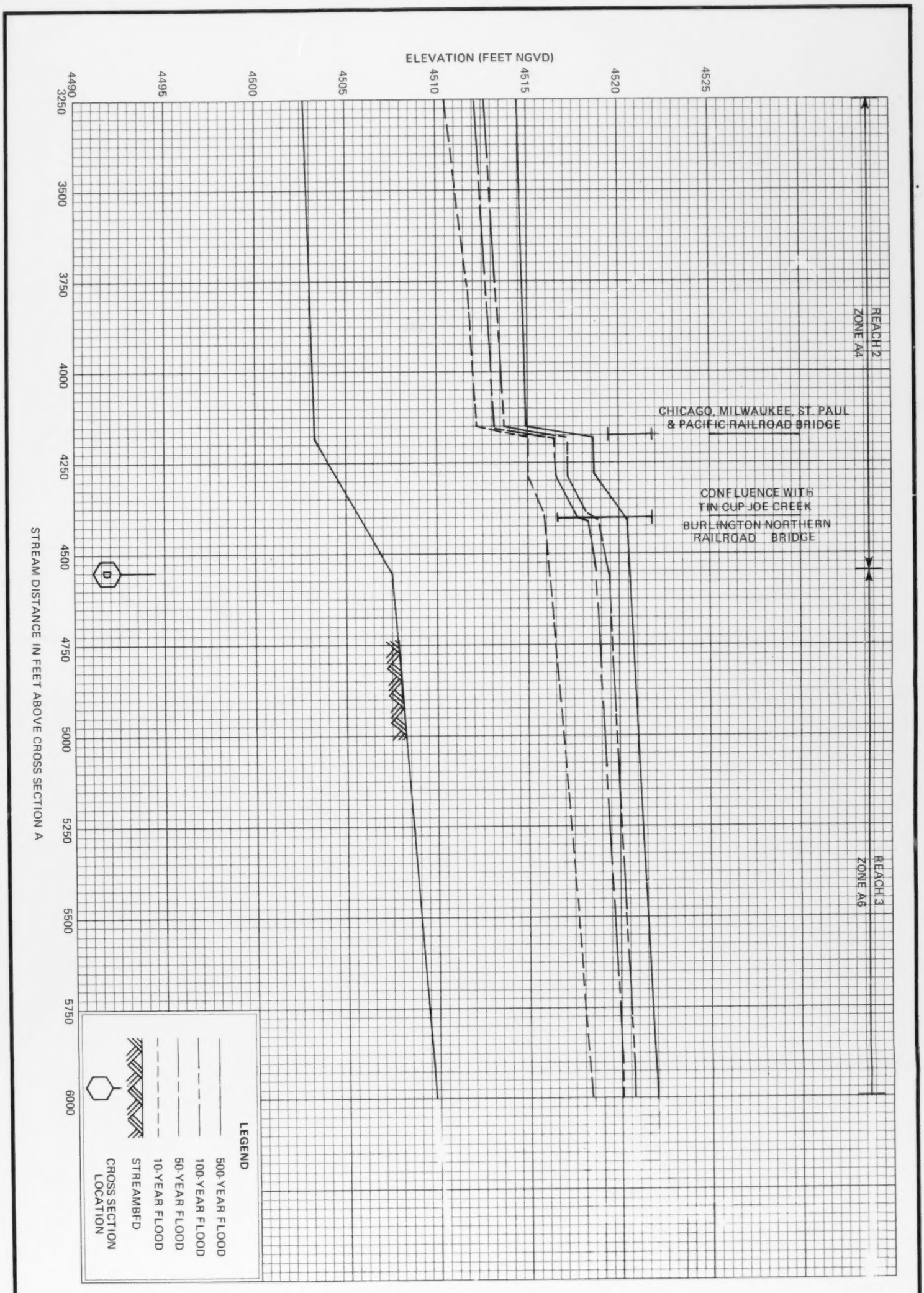
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF DEER LODGE AND POWELL COUNTY, MT

FLOOD PROFILES

CLARK FORK

01P



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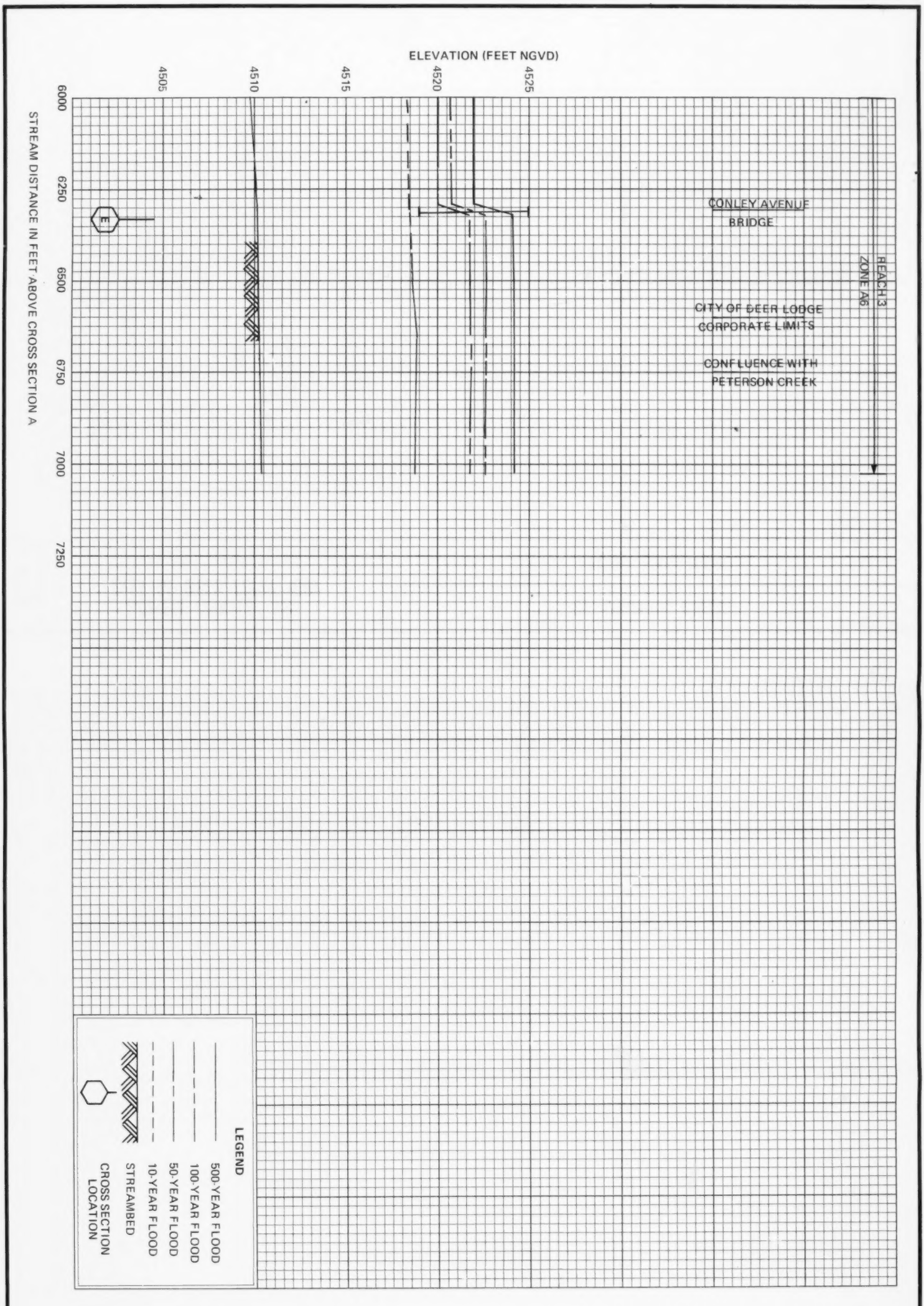
CITY OF DEER LODGE AND POWELL COUNTY, MT

FLOOD PROFILES

CLARK FORK



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CITY OF DEER LODGE AND POWELL COUNTY, MT

FLOOD PROFILES

CLARK FORK

03P

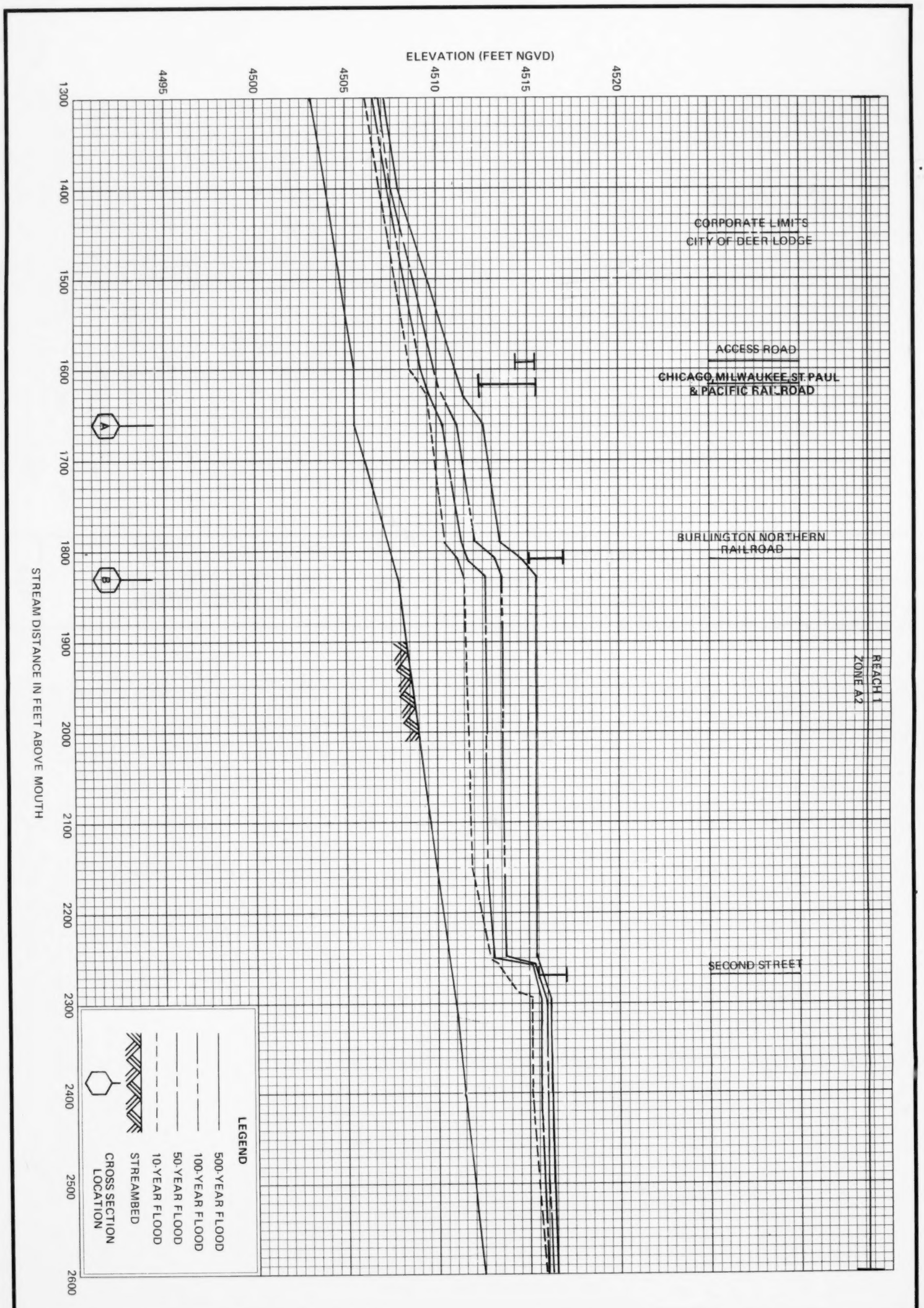
FLOOD PROFILES

COTTONWOOD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF DEER LODGE AND POWELL COUNTY, MT

04P



05P

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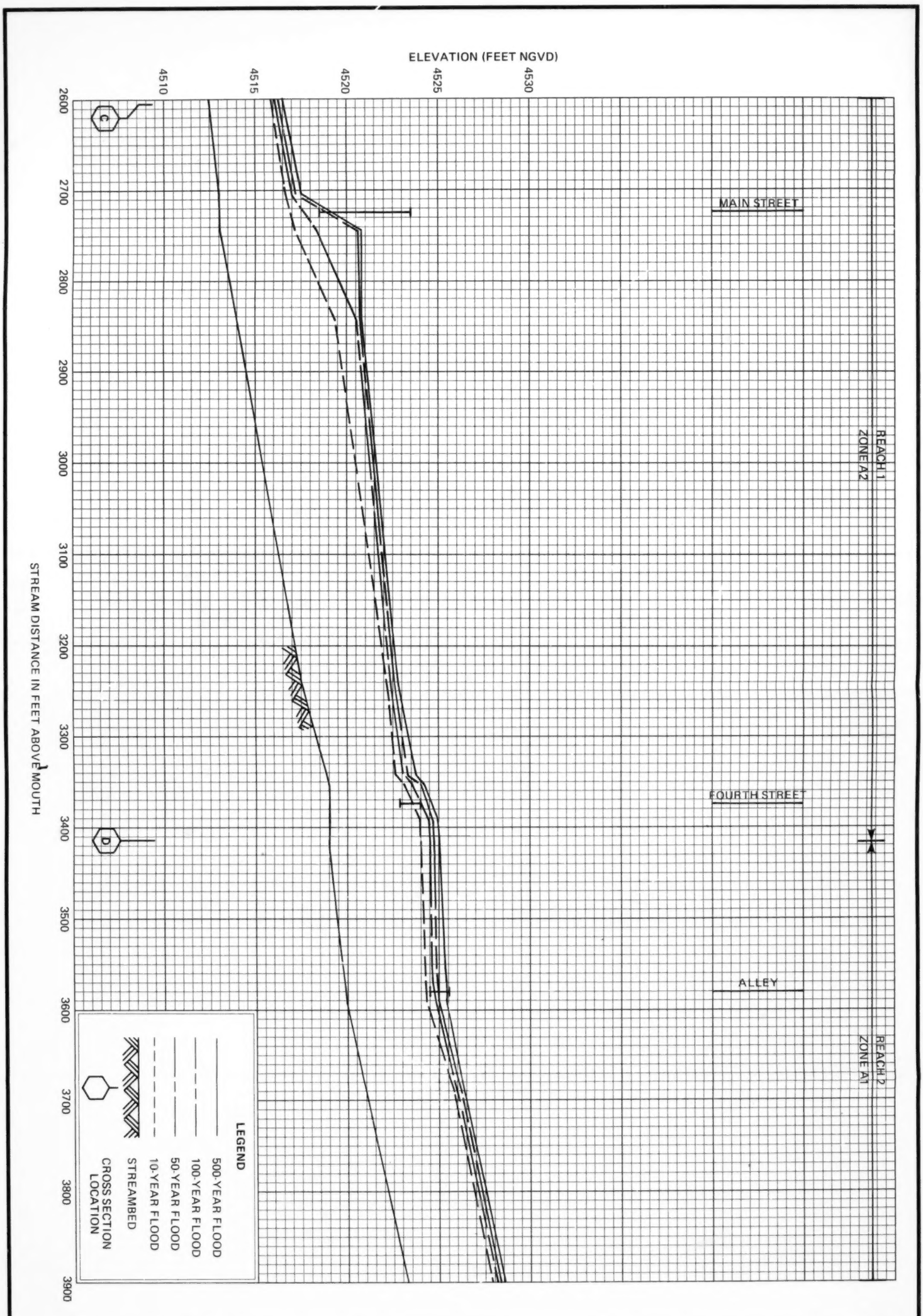
CITY OF DEER LODGE AND POWELL COUNTY, MT

FLOOD PROFILES

COTTONWOOD CREEK



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CITY OF DEER LODGE AND POWELL COUNTY, MT

FLOOD PROFILES

COTTONWOOD CREEK

06P

REACH 2
ZONE A1

FIFTH STREET
ALLEY
CLARK STREET
ALLEY

ELEVATION (FEET NGVD)

4545
4540
4535
4530
4525
4520

E
F

3900 4000 4100 4200 4300 4400 4500 4600 4700 4800 4900 5000 5100 5200

STREAM DISTANCE IN FEET ABOVE MOUTH

LEGEND
- 500-YEAR FLOOD
- 100-YEAR FLOOD
- 50-YEAR FLOOD
- 10-YEAR FLOOD
- STREAMBED
- CROSS SECTION LOCATION

FLOOD PROFILES

COTTONWOOD CREEK

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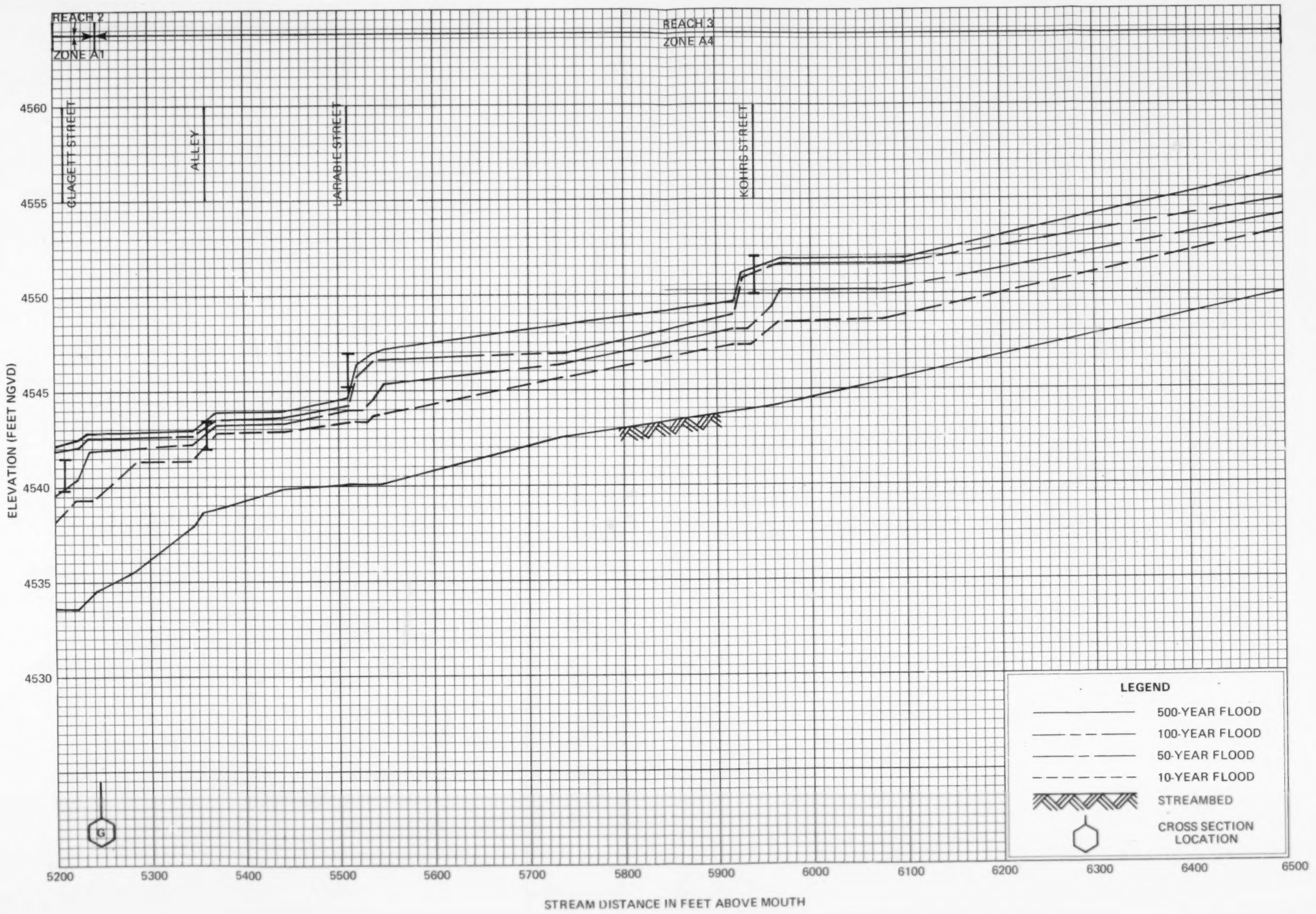
CITY OF DEER LODGE AND POWELL COUNTY, MT

07P



FLOOD PROFILES

COTTONWOOD CREEK

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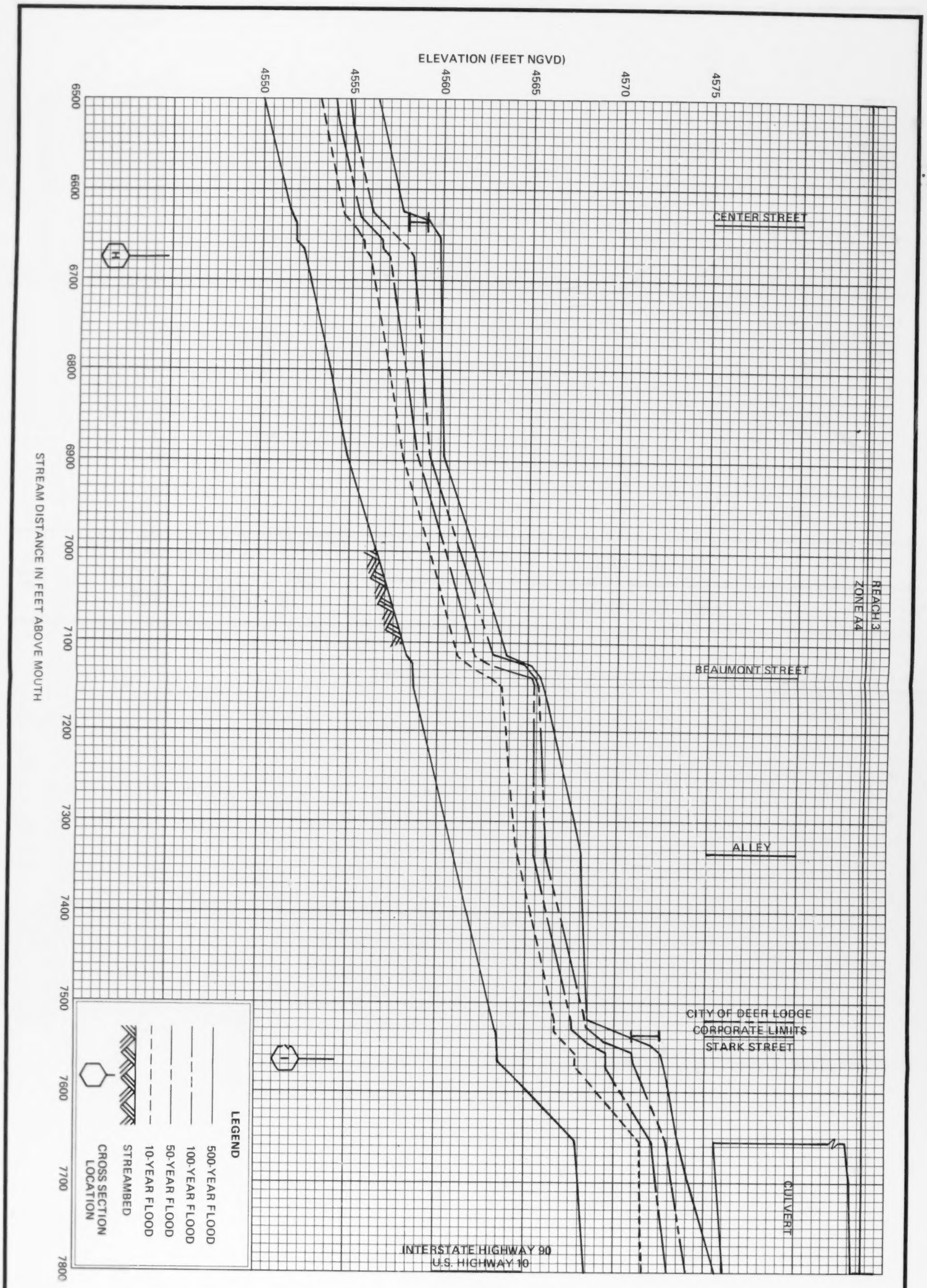
CITY OF DEER LODGE AND
POWELL COUNTY, MT

08P



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CITY OF DEER LODGE AND POWELL COUNTY, MT

FLOOD PROFILES

COTTONWOOD CREEK

09P

REACH 3
ZONE A4

4590
4585
4580
4575
4570
4565
4560
4555
4550

CULVERT

LIMIT OF DETAILED STUDY

ELEVATION (FEET NGVD)

7800
7900
8000

STREAM DISTANCE IN FEET ABOVE MOUTH

LEGEND

- 500 - YEAR FLOOD
- 100 - YEAR FLOOD
- 50 - YEAR FLOOD
- 10 - YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

COTTONWOOD CREEK

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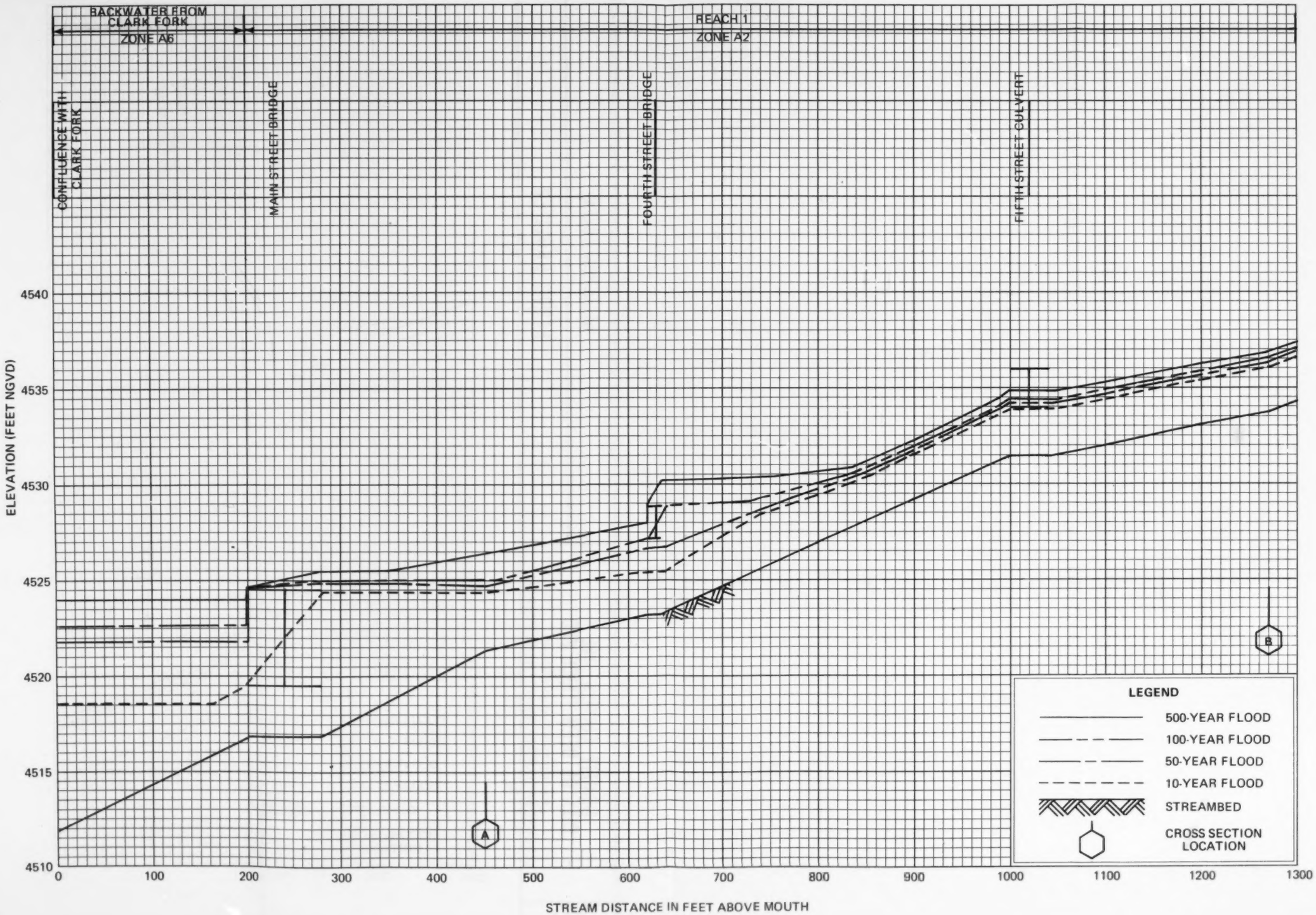
POWELL COUNTY, MT

10P



FLOOD PROFILES

PETERSON CREEK

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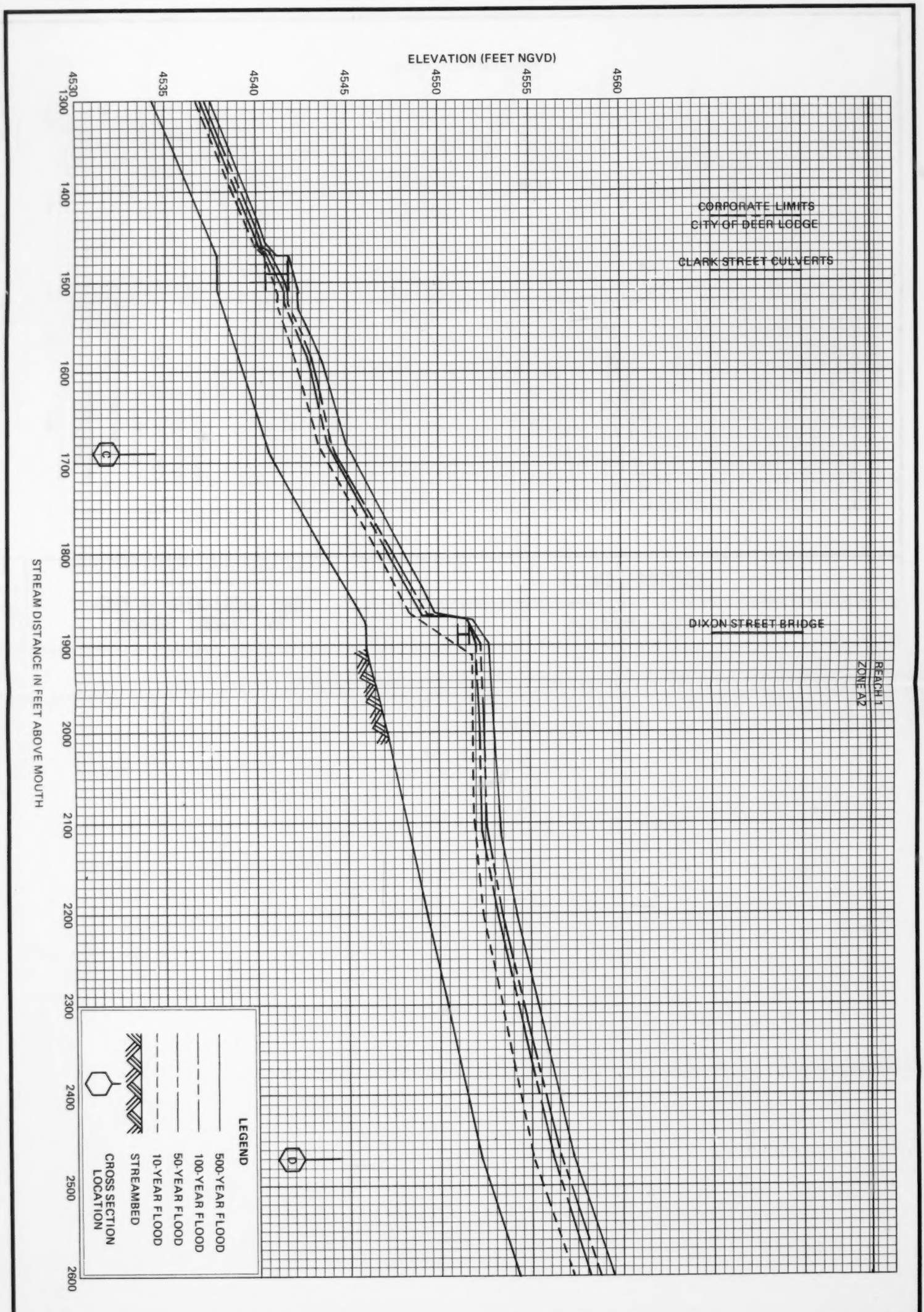
11P



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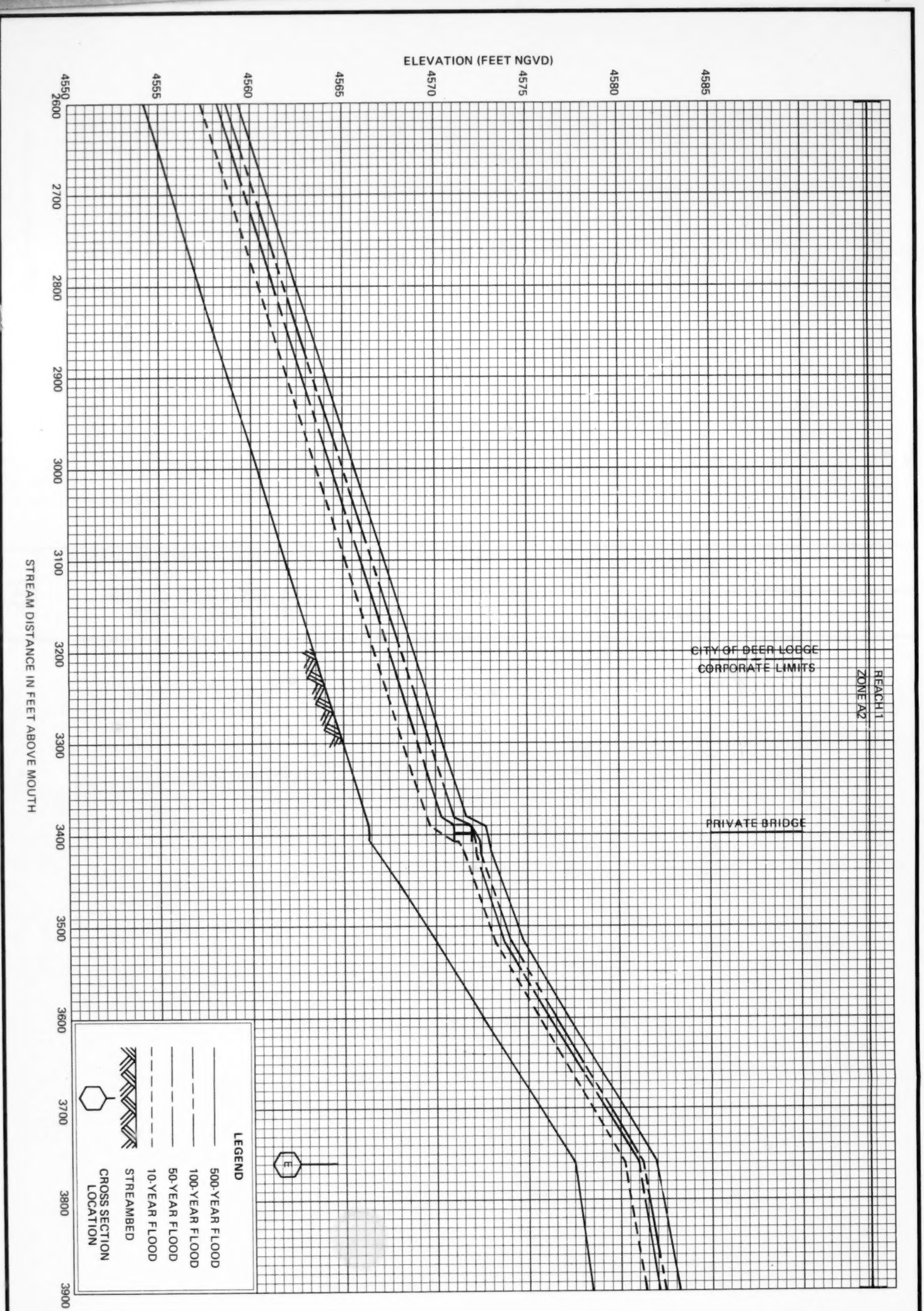
CITY OF DEER LODGE AND POWELL COUNTY, MT

FLOOD PROFILES

PETERSON CREEK



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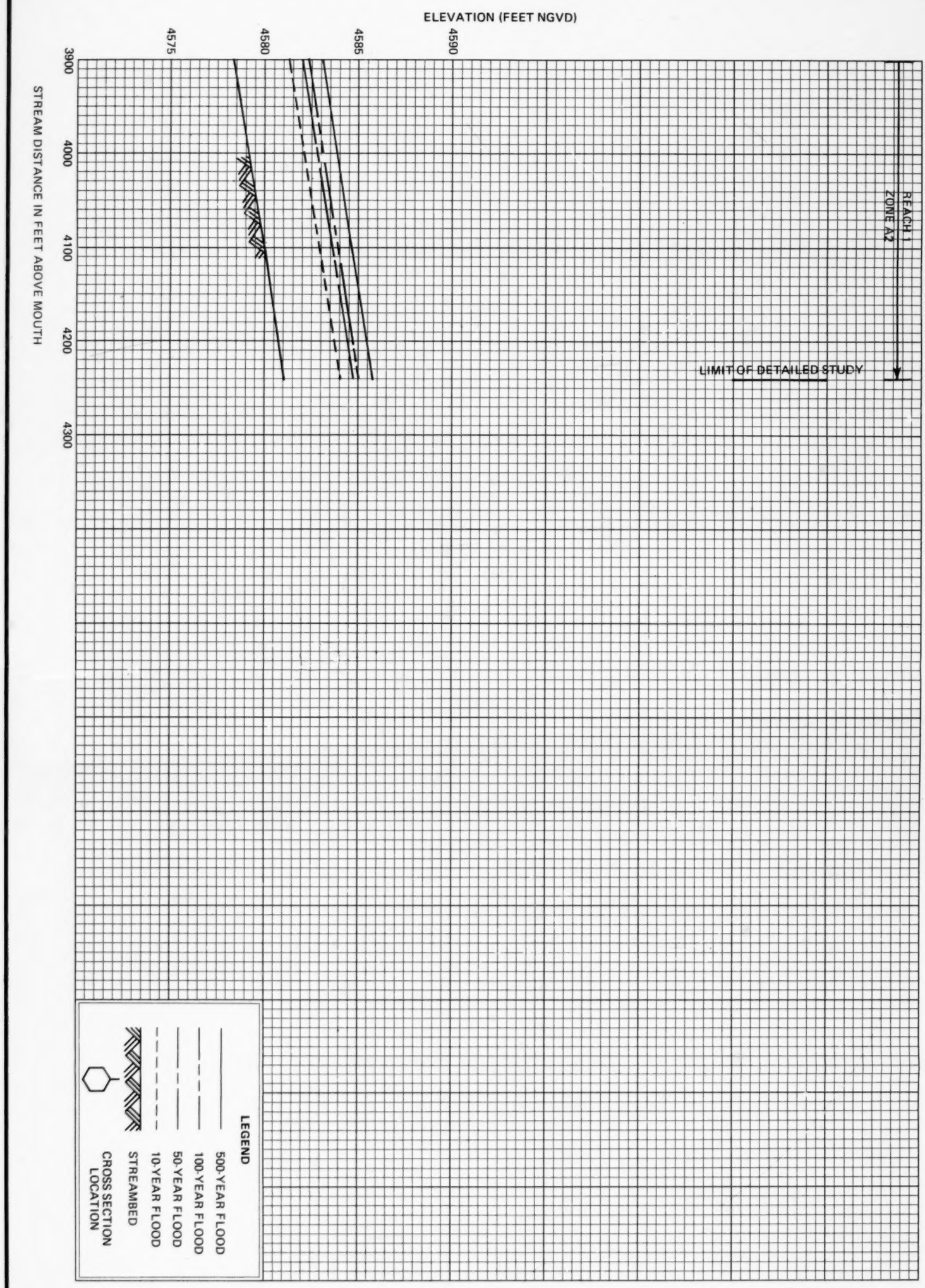
FLOOD PROFILES

PETERSON CREEK



14P	FEDERAL EMERGENCY MANAGEMENT AGENCY Federal Insurance Administration **CITY OF DEER LODGE AND POWELL COUNTY, MT**	**FLOOD PROFILES** **PETERSON CREEK**